

Iteration #2 Results

Alternatives (2A-TC, 2A-TT, 2B-TC)

SRT Meeting – February 14, 2013
Presenter (Nancy Stephan, Matt
Rea, Steve Smith, Bob Heinith)

2RC-CC

Current Operating Condition

Alternative Objective:

Establish the reference case using the current operation of the Columbia River System following the current operating protocols and procedures under the Columbia River Treaty. Used for comparison to modeled future alternatives and components.

2RC-CC Modeling Assumptions

- Current configuration of the Columbia River System with no major changes in levees, dams, and reservoirs from the current system.
- Flood Risk Management based on current Flood Control Operating Plan.
- Current operating criteria and objectives.
- Loads and resources are projected 2024 levels.
- Attempts to manage the flows at The Dalles to below 450 thousand cubic feet per second (kcfs).

Alternative

An alternative consists of a system of operational, structural and/or non-structural measures formulated to meet the identified study objectives subject to the study constraints.

2A-TC

Treaty Continues, Called Upon, Current U.S. SRDs

Alternative Objective:

To assess the Treaty Continues operation using a Called Upon procedure to access Canadian storage and coordinated power operations with Canada.

2A-TC Modeling Assumptions

- Current configuration of the Columbia River System with no changes in levees, dams, and reservoirs from the current system.
- Flood Risk Management:
 - Effective Use is implemented at U.S. reservoirs prior to calling Canada for additional storage.
 - Canadian Storage Reservation Diagrams (SRDs) are replaced with the Called Upon procedure.
 - Current SRDs are used in the U.S. to attempt to manage flows to 450 kcfs or below at The Dalles.

2A-TT

Treaty Terminates, Called Upon, Current U.S. SRDs

Alternative Objective:

To assess the Treaty Terminates operation using a Called Upon procedure to access storage in Canada and NO coordinated power operations with Canada.

2A-TT Modeling Assumptions

- Current configuration of the Columbia River System with no changes in levees, dams, and reservoirs from the current system.
- Flood Risk Management:
 - Effective Use is implemented at U.S. reservoirs prior to calling Canada for additional storage.
 - Canadian Storage Reservation Diagrams (SRDs) are replaced with the Called Upon procedure.
 - Current SRDs are used in the U.S. to attempt to manage flows to 450 kcfs or below at The Dalles.

2A-TT Modeling Assumptions

- Knowledge of Canadian operation is uncertain. Flood operations will assume uncertainty in Canadian drafts. Five potential Treaty Terminates Canadian operations were evaluated. The most likely Canadian operations was used to assess impacts.

2B-TC

Treaty Continues, Called Upon, Modified SRDS at Selected US Reservoirs

Alternative Objective:

To assess the impacts and benefits of reducing the amount of system authorized flood storage in certain U.S. reservoirs while implementing Called Upon procedures and coordinated power operation with Canada.

2B-TC Modeling Assumptions

- Current system SRDs are used at Libby and Hungry Horse. Revised SRDs are used at Grand Coulee, Dworshak, and Brownlee resulting in less draft on average for these projects.
- Local flood control is maintained.
- Revised Called Upon procedures to manage only very large forecasted flow events.
- Attempts to manage the flows at The Dalles to below 600 thousand cubic feet per second (kcfs).

Comparison of Iteration #1 & #2 Alternatives

2RC-CC: Current Condition

2A-TC: 450, Called Upon, Treaty Continues

2A-TT: 450, Called Upon, Treaty Terminates

2B-TC: 600, Called Upon, Treaty Continues

Iteration #2 – Key Changes

- 10 modeling changes were made between Iteration #1 and Iteration #2
- 3 of 10 modeling changes accounted for most of the changes seen in results
- All results were expected
- Changes seen mainly at Libby, Hungry Horse, Mica, Arrow and Grand Coulee

Iteration #1 to Iteration #2 3 Significant Changes Modeling

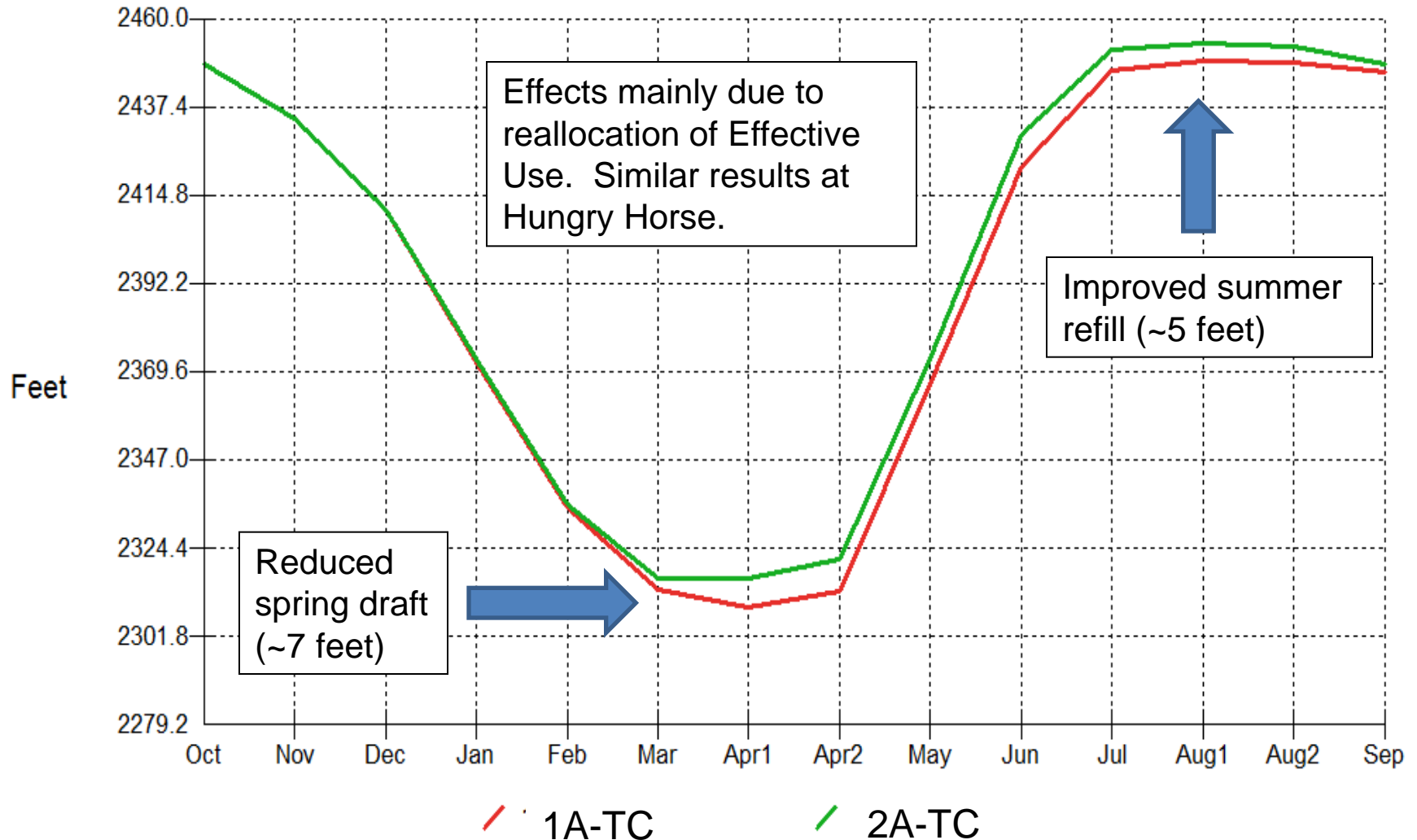
- Re-Proportioning of Effective Use flood control storage from Libby and Hungry Horse to Grand Coulee
- Change in modeling approach for Canadian Flex operations at Mica & Arrow
- Change in Grand Coulee operations for chum salmon and Vernita Bar fall Chinook flows in low water years

LIBBY - Elevations

1A-TC to 2A-TC

20% High Water Years

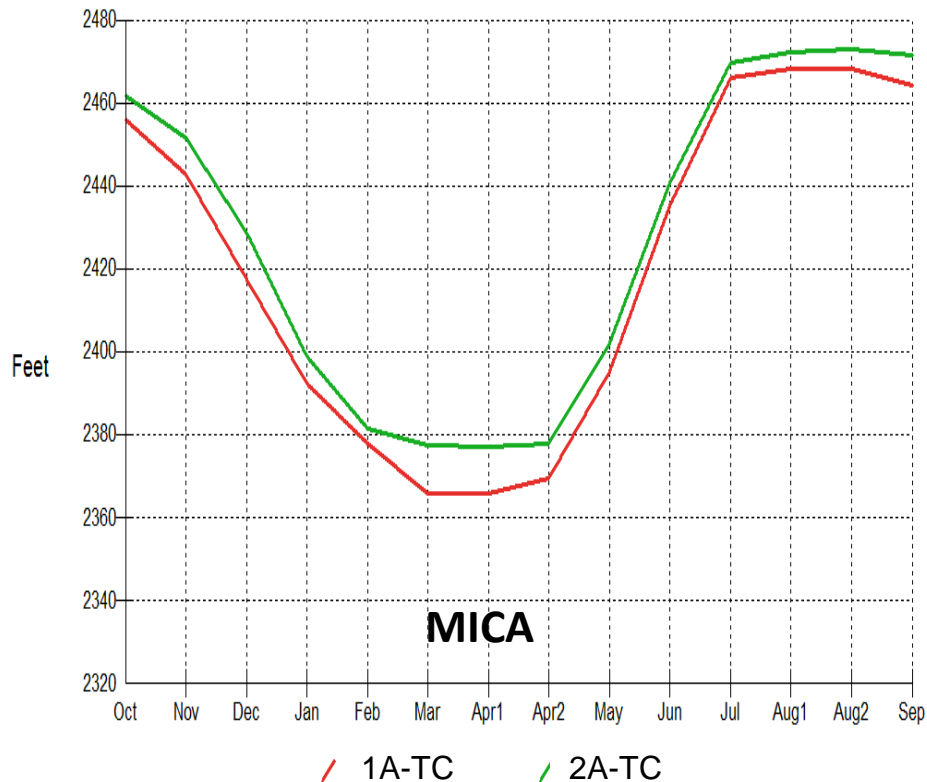
Reservoir Elevation: Libby (wyr H20): Full=2459 Empty=2287



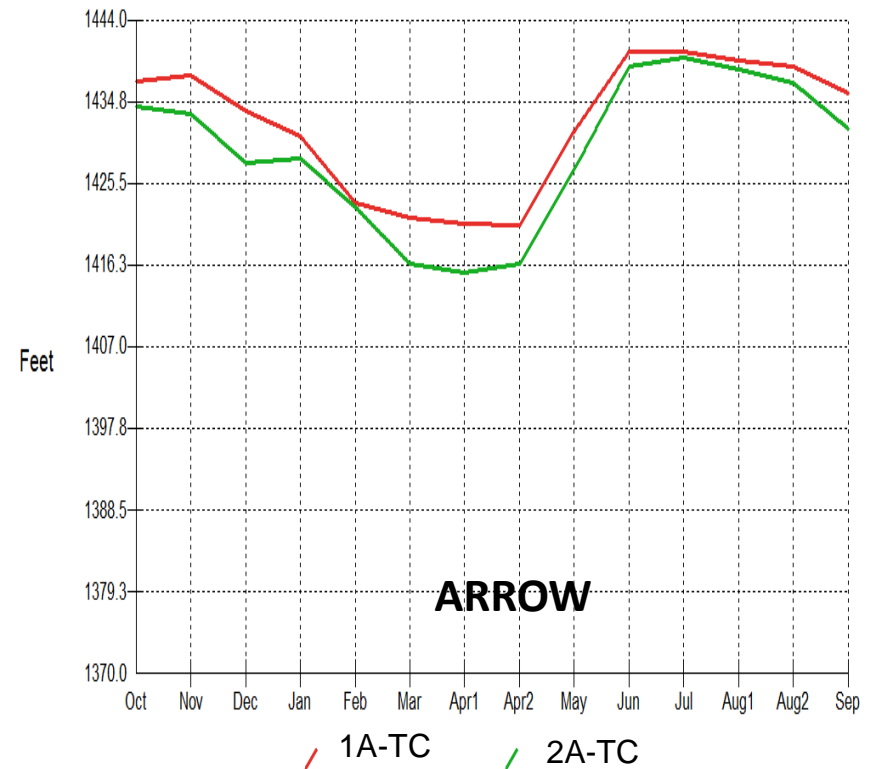
MICA & ARROW - Elevations

1A-TC to 2A-TC 70 Water Years

Reservoir Elevation:Mica (wyr ALL):Full=2474.7 Empty=2320



Reservoir Elevation:Arrow Lakes (wyr ALL):Full=1444 Empty=1378

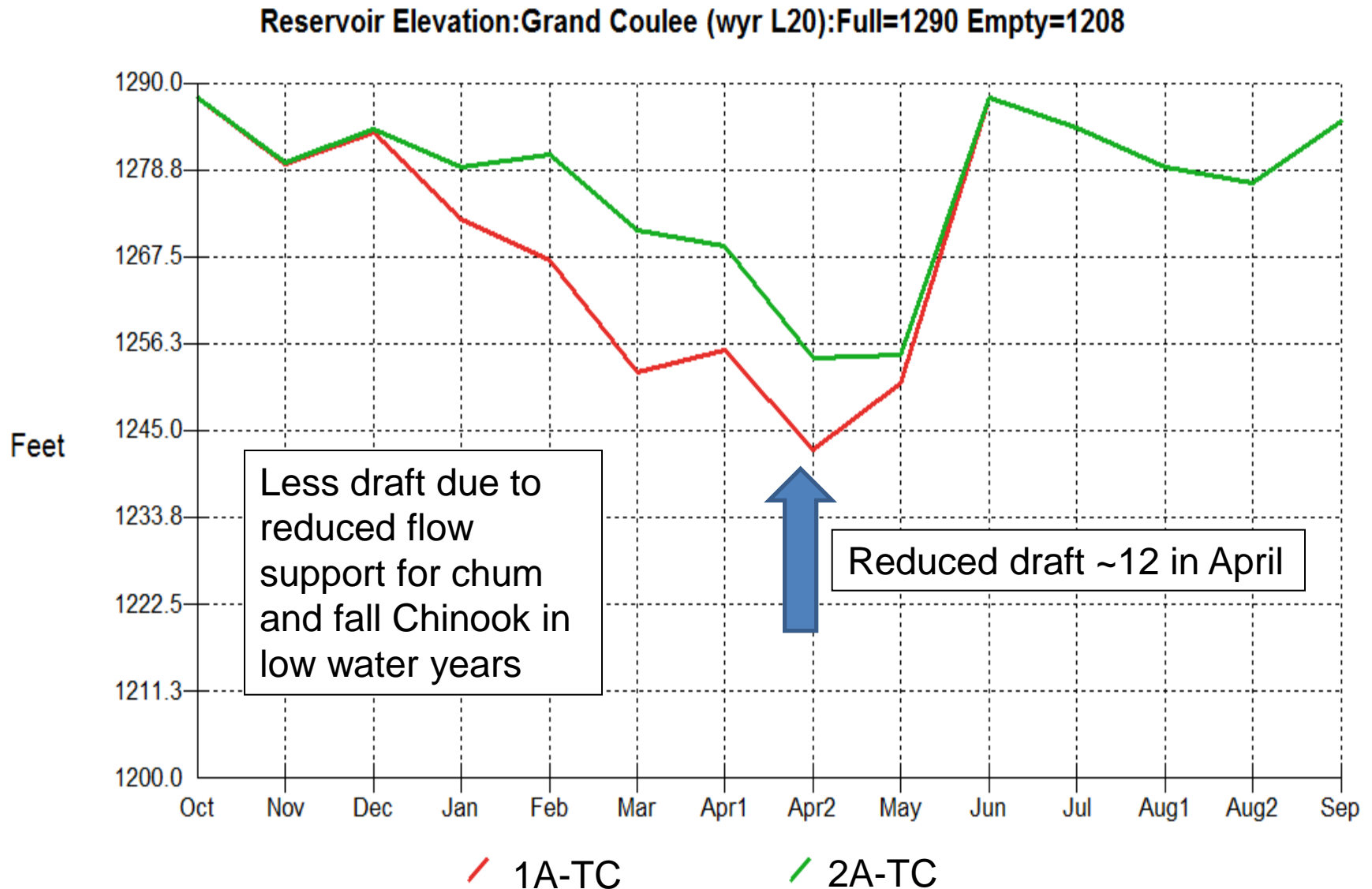


Changes to FLEX operations and Called Upon calculation resulted in Mica being fuller and Arrow drafting deeper.

GRAND COULEE - Elevations

1A-TC to 2A-TC

20% Low Water Years

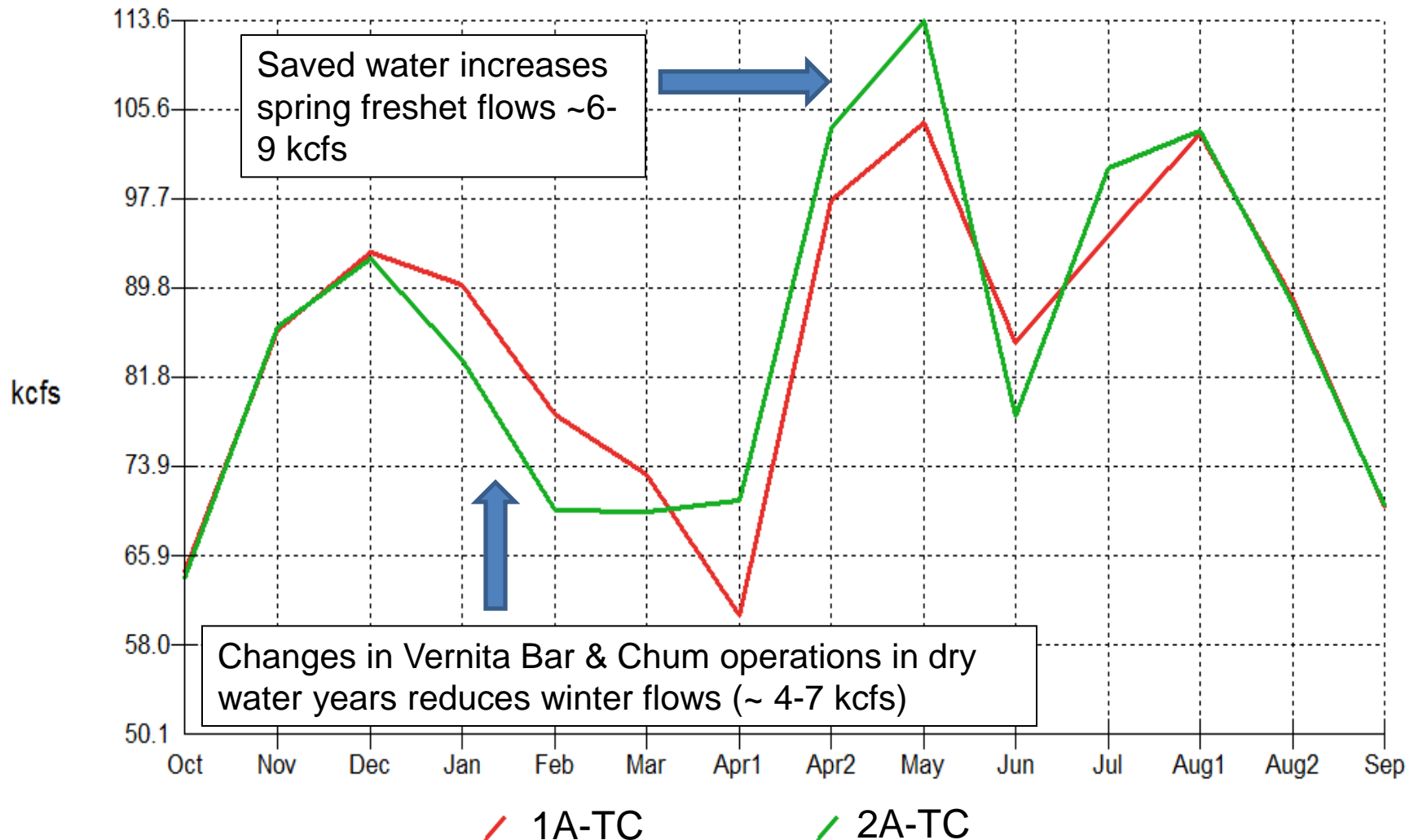


GRAND COULEE - Outflow

1A-TC to 2A-TC

20% Low Water Years

Regulated Outflows:Grand Coulee (wyr L20)

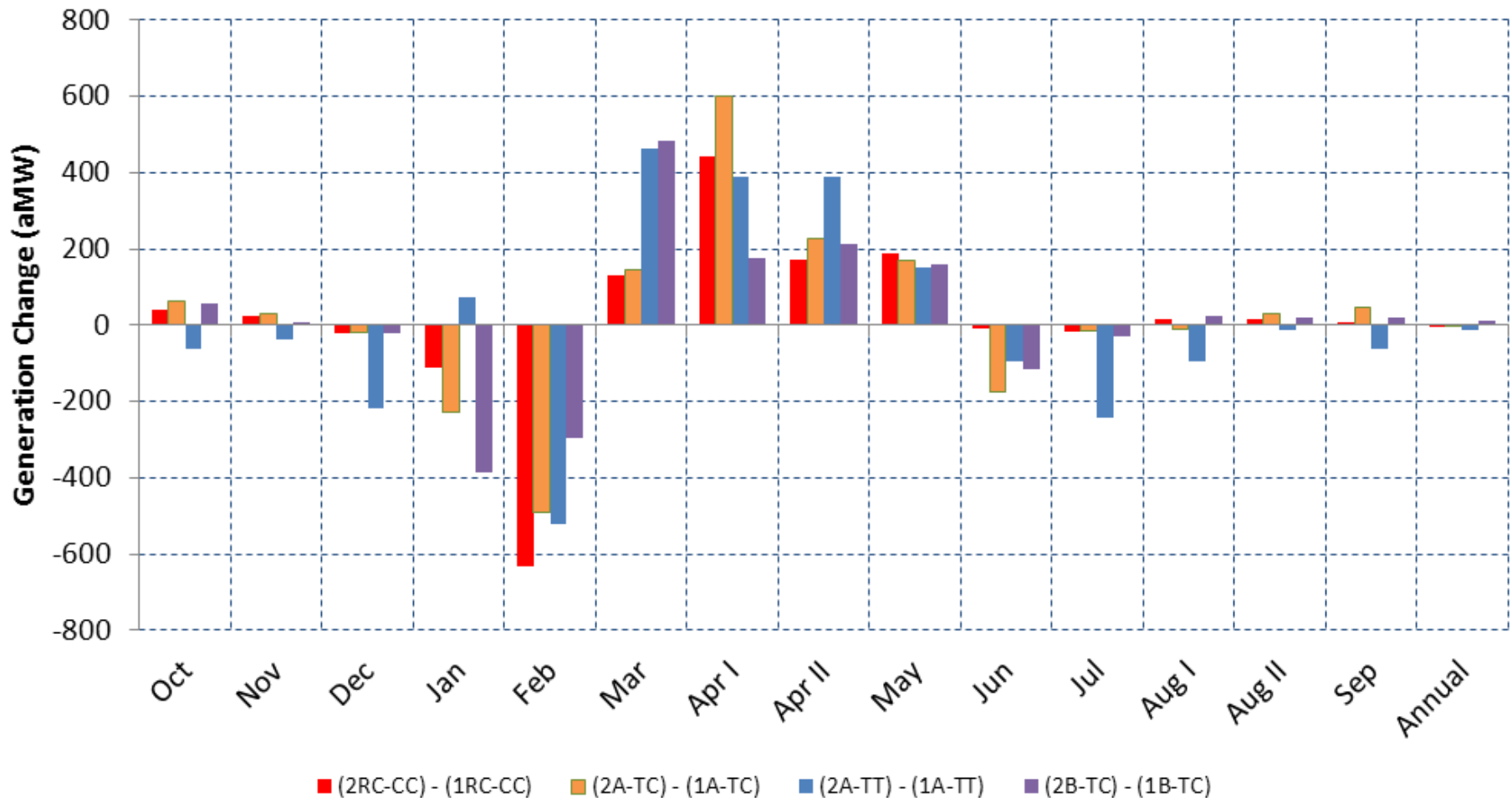


Probabilities of EU and CU

Alternative	Iteration 1		Iteration 2	
	Probability of Effective Use	Probability of Called Use	Probability of Effective Use	Probability of Called Use
RC-CC: Reference Condition - Current Operating Condition (Post 2024)	N/A	15.7%	N/A	5.7%
1A-TC to 2A-TC: Treaty Continues with CU/EU and current SRDs in the U.S.	25.7%	5.7%	17.5%	5.4%

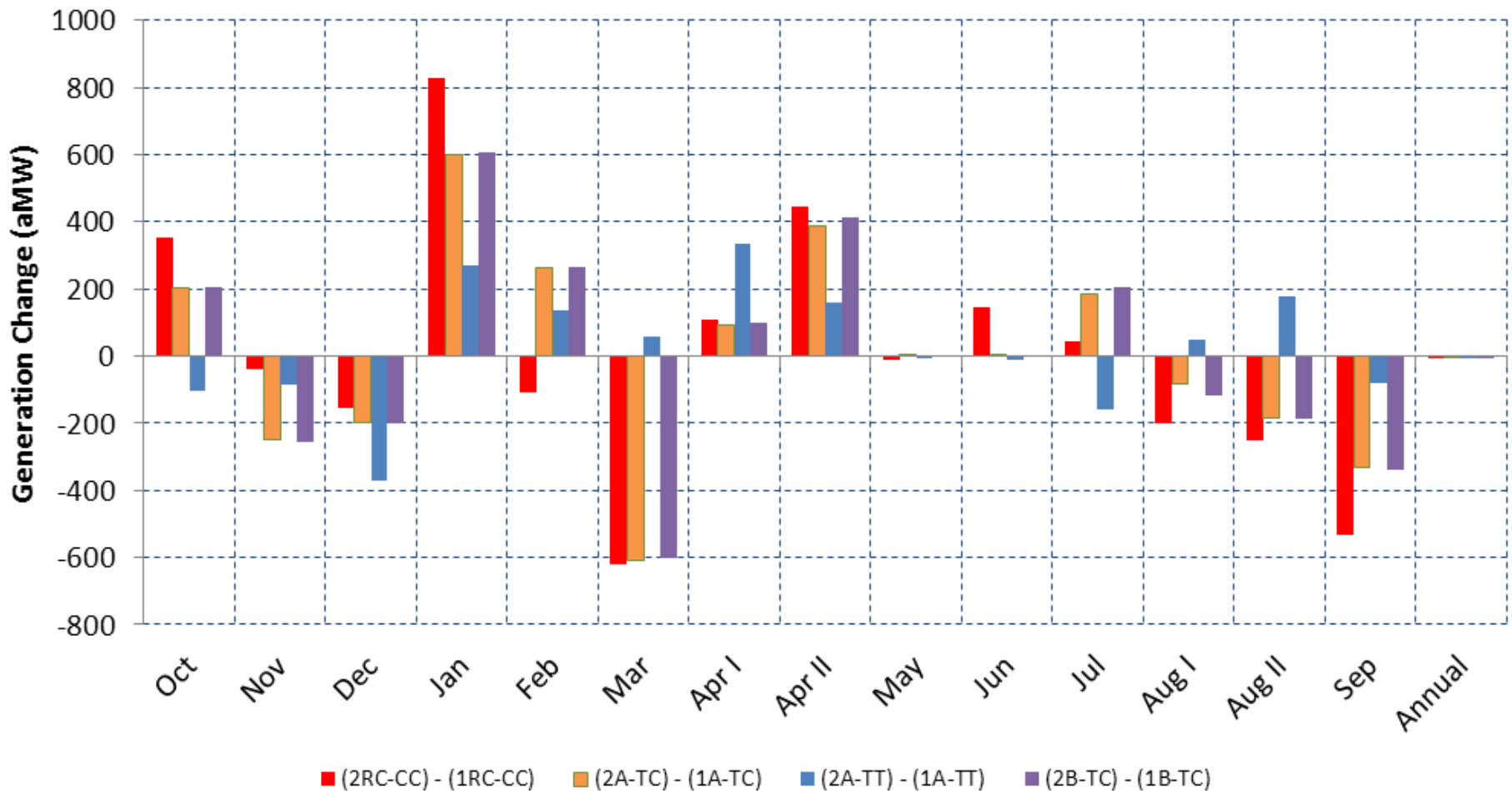
Columbia River Treaty 2014/2024 Review

US System Generation: Change in Generation from Iteration 1 Modeling to Iteration 2 (I2-I1)



Columbia River Treaty 2014/2024 Review

Canadian System Generation: Change in Generation from Iteration 1 Modeling to Iteration 2 (I2-I1)



Iteration #2 Alternatives

2A-TC: 450, Called Upon, Treaty Continues

2A-TT: 450, Called Upon, Treaty Terminates

2B-TC: 600, Called Upon, Treaty Continues

Compared to Current Condition 2RC-CC

KOOTENAI RIVER BASIN

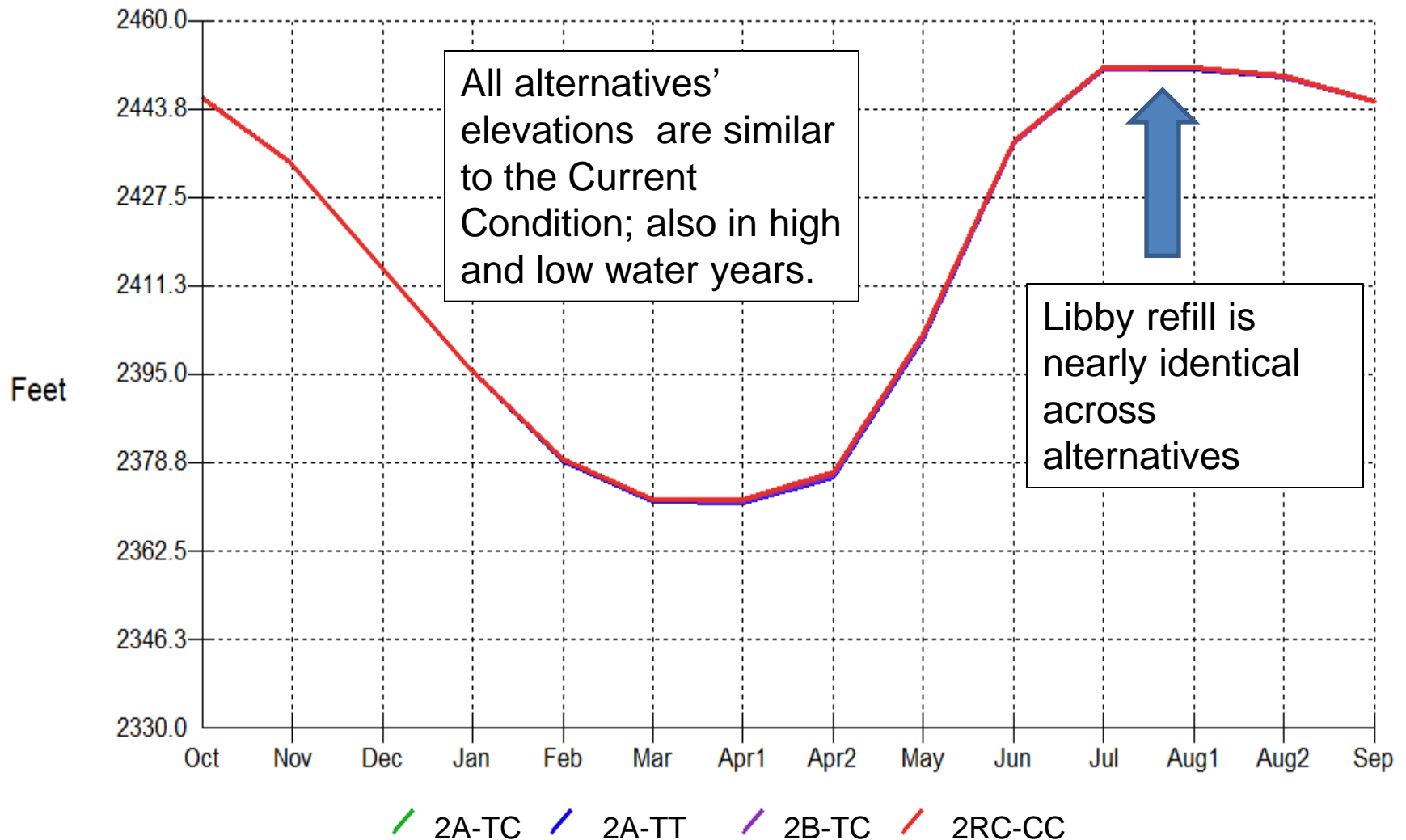
Lake Koocanusa above Libby Dam

Kootenai River below Libby Dam

LIBBY

Elevation – 70 Water Years

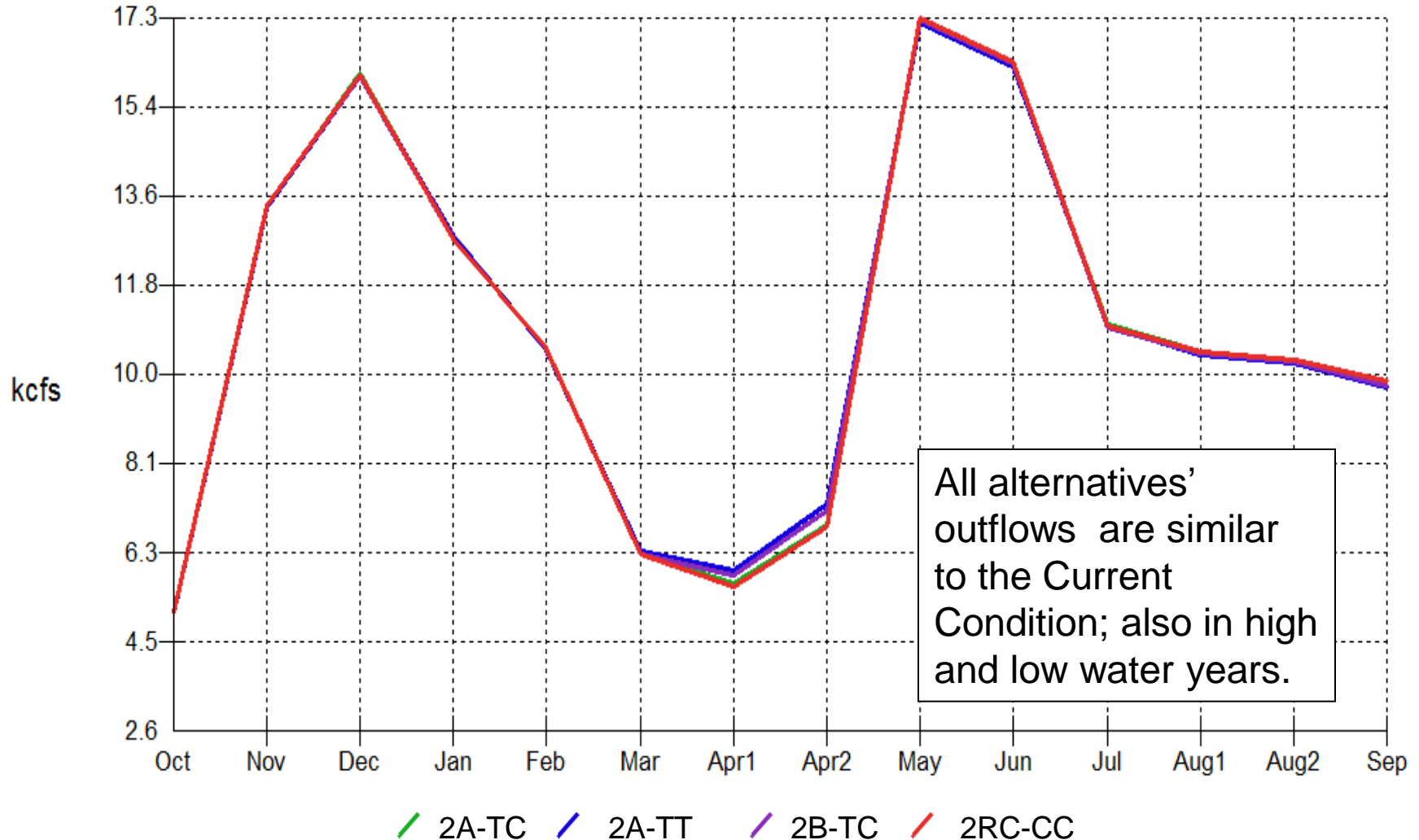
Reservoir Elevation: Libby (wyr ALL): Full=2459 Empty=2287



LIBBY

Libby Outflows – 70 Water Years

Regulated Outflows:Libby (wyr ALL)



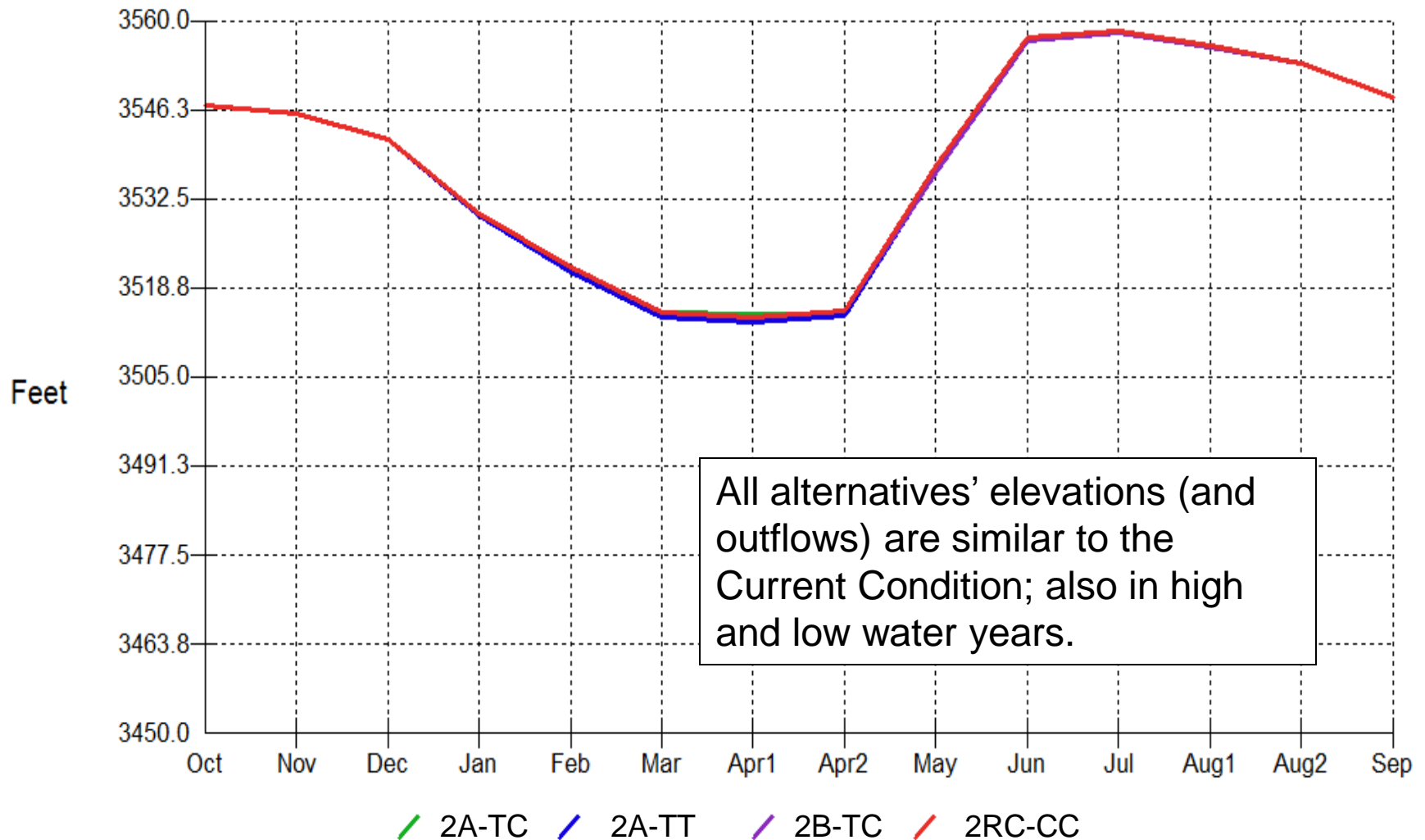
FLATHEAD RIVER BASIN

- **Hungry Horse Reservoir**
- **S.F. Flathead River**
- **Flathead River @ Columbia Falls**
- **Flathead Lake**
- **Flathead River below Kerr Dam**

HUNGRY HORSE RESERVOIR

Elevation – 70 Water Years

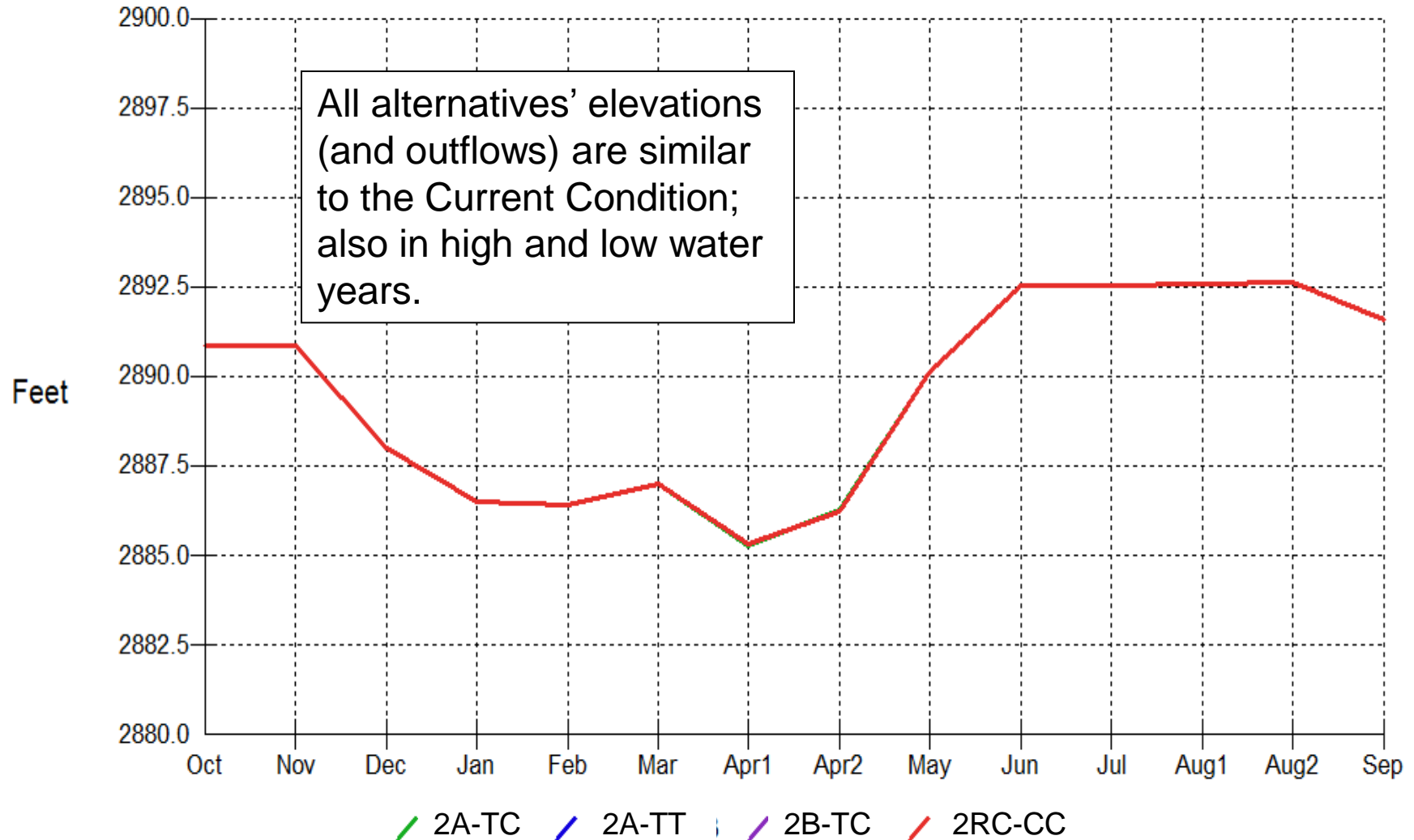
Reservoir Elevation: Hungry Horse (wyr ALL): Full=3560 Empty=3336



FLATHEAD LAKE

Elevation – 70 Water Years

Reservoir Elevation:Kerr (wyr ALL):Full=2893 Empty=2883



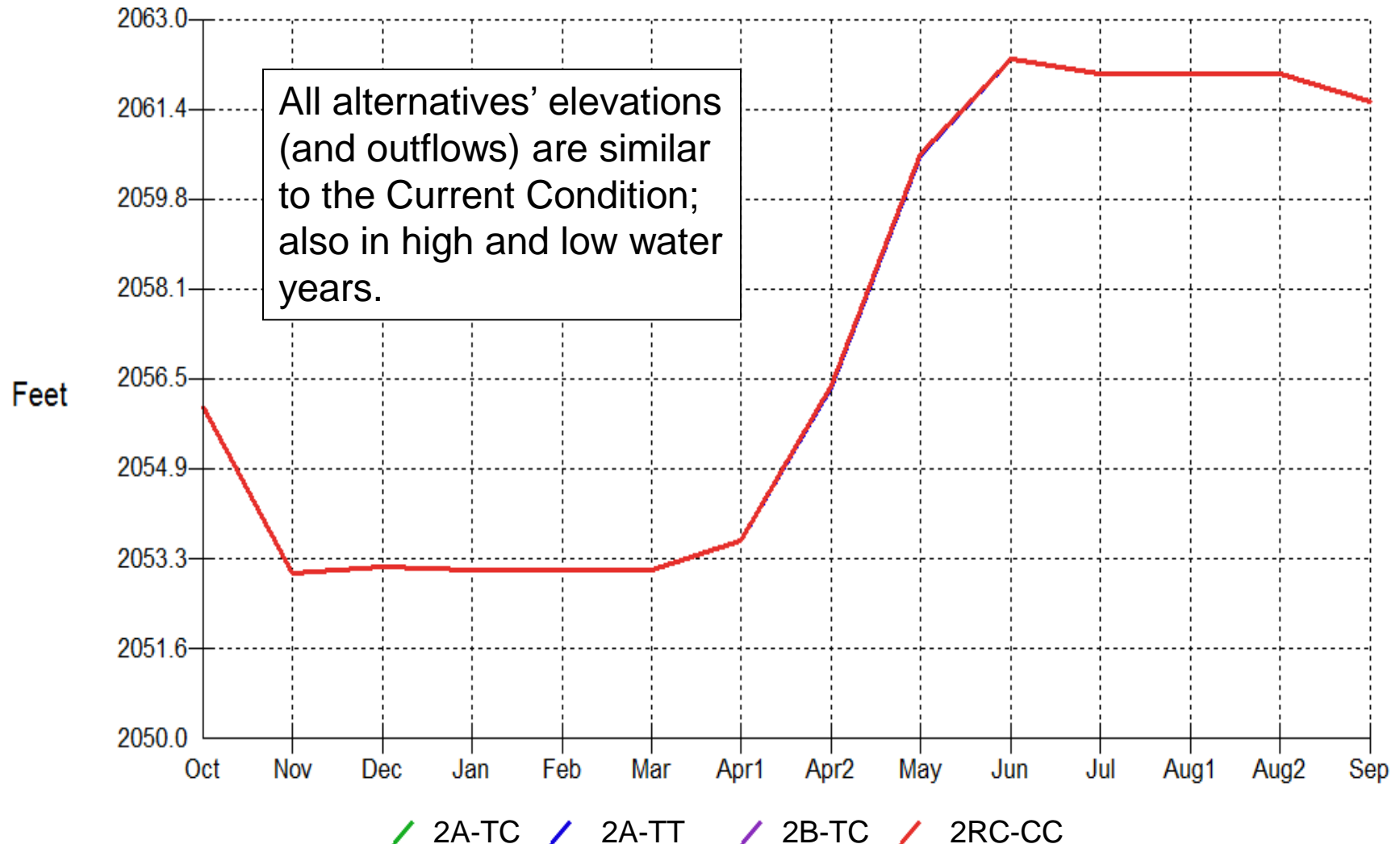
PEND OREILLE RIVER BASIN

- **Clark Fork River at Cabinet Gorge Dam**
- **Lake Pend Oreille above Albeni Falls Dam**
- **Pend Oreille River below Albeni Falls Dam**

LAKE PEND OREILLE

Elevation – 70 Water Years

Reservoir Elevation:Albeni Falls (wyr ALL):Full=2062.5 Empty=2049.7

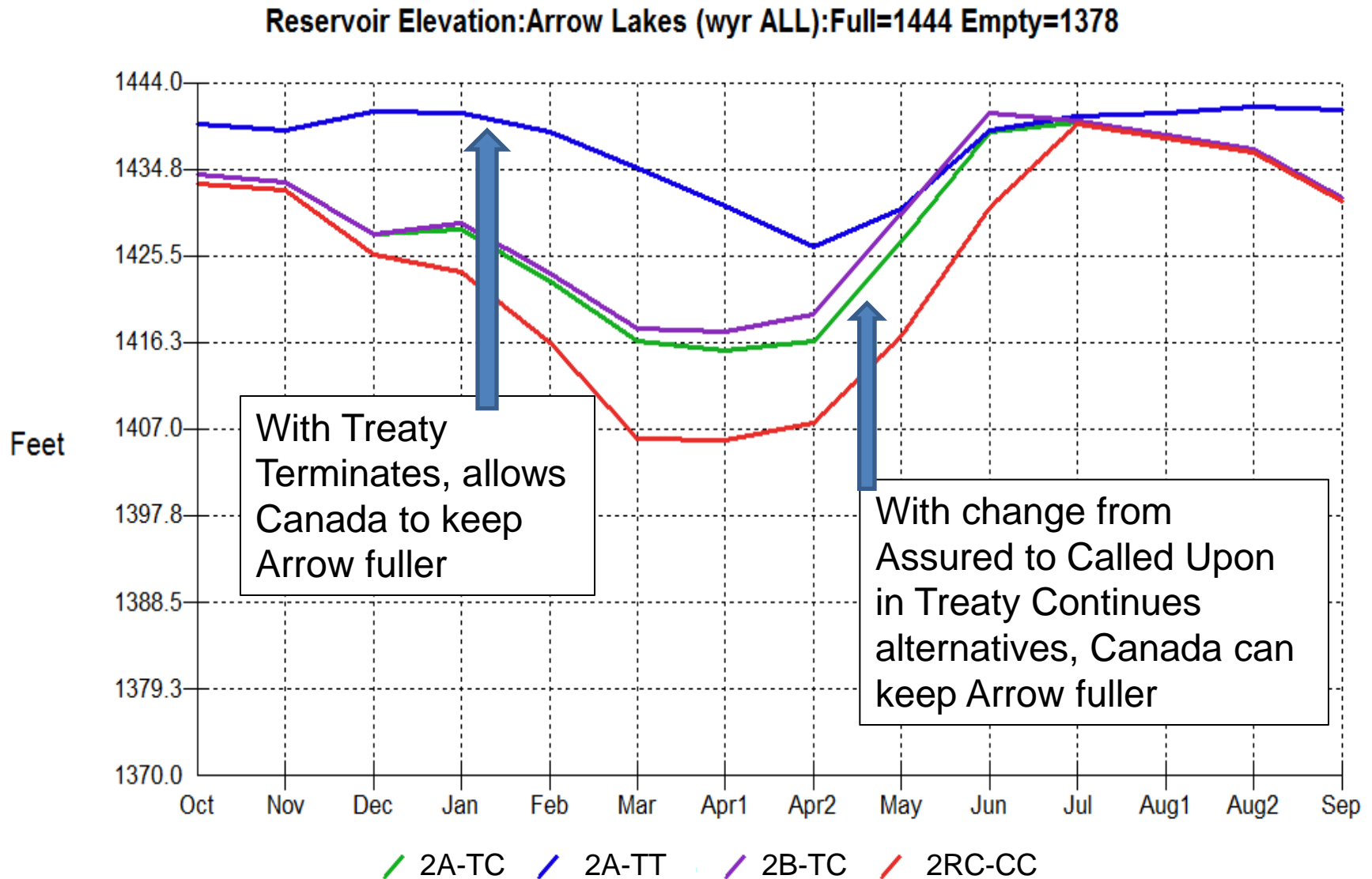


CANADIAN PROJECTS

- **MICA DAM**
- **DUNCAN**
- **ARROW LAKES, Hugh Keenleyside Dam**

ARROW LAKES

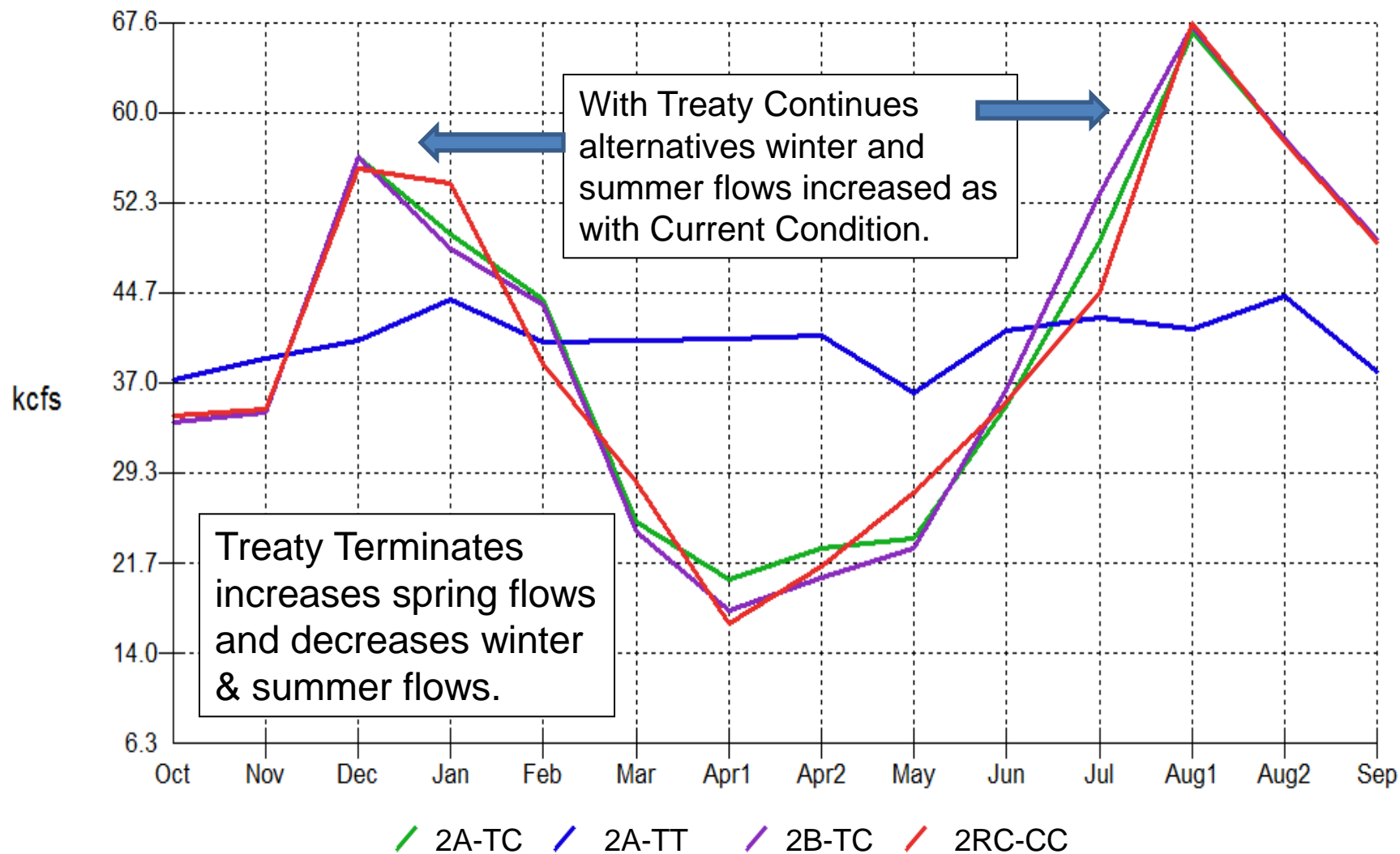
Elevation – 70 Water Years



ARROW LAKES

Outflows – 70 Water Years

Regulated Outflows: Arrow Lakes (wyr ALL)



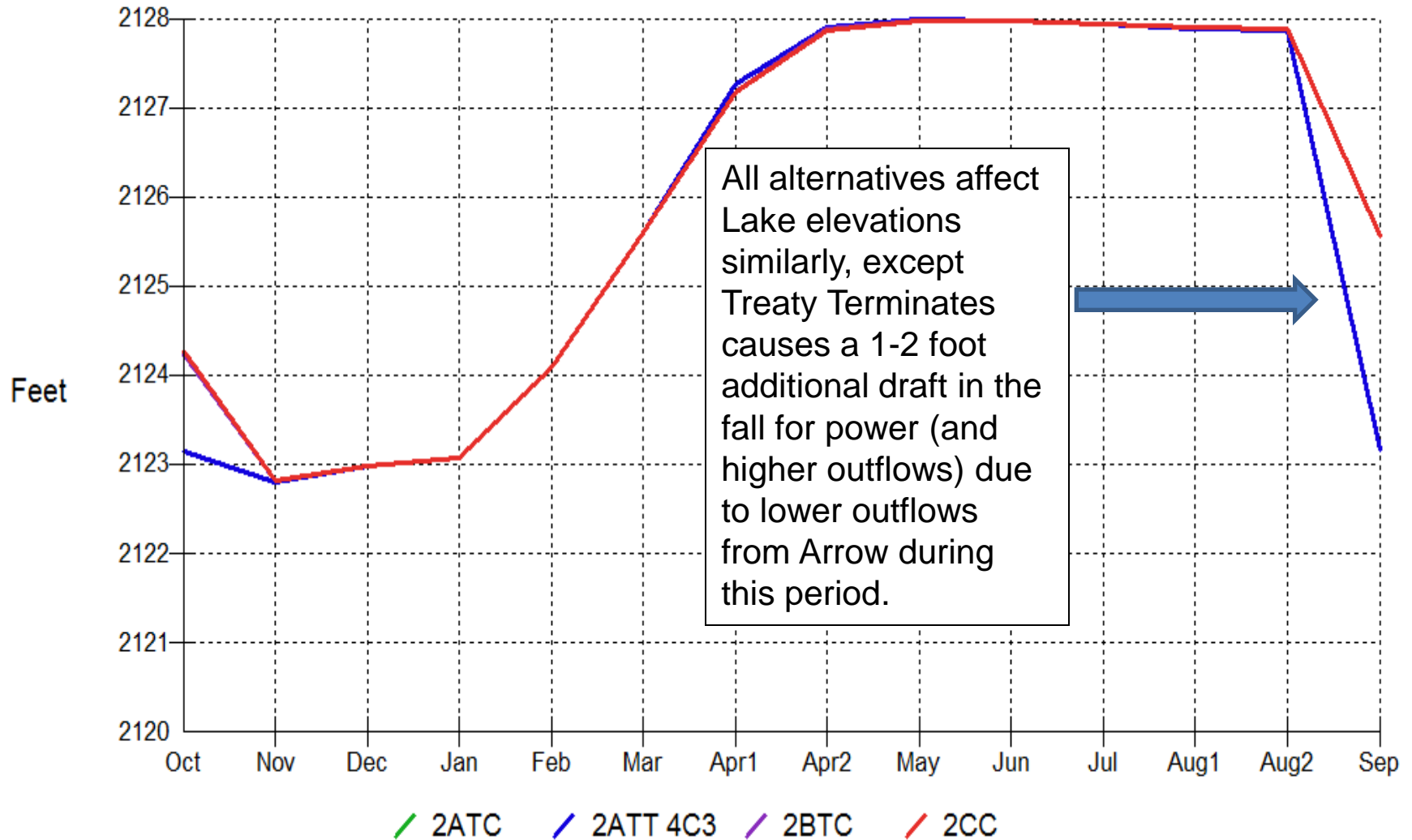
SPOKANE RIVER BASIN

- **Lake Coeur d'Alene**
- **Spokane River below Post Falls Dam**

LAKE COEUR d'ALENE

Elevations – 70 Water Years

Reservoir Elevation:Coeur d Alene Lake (wyr ALL):Full=2128 Empty=2120.5

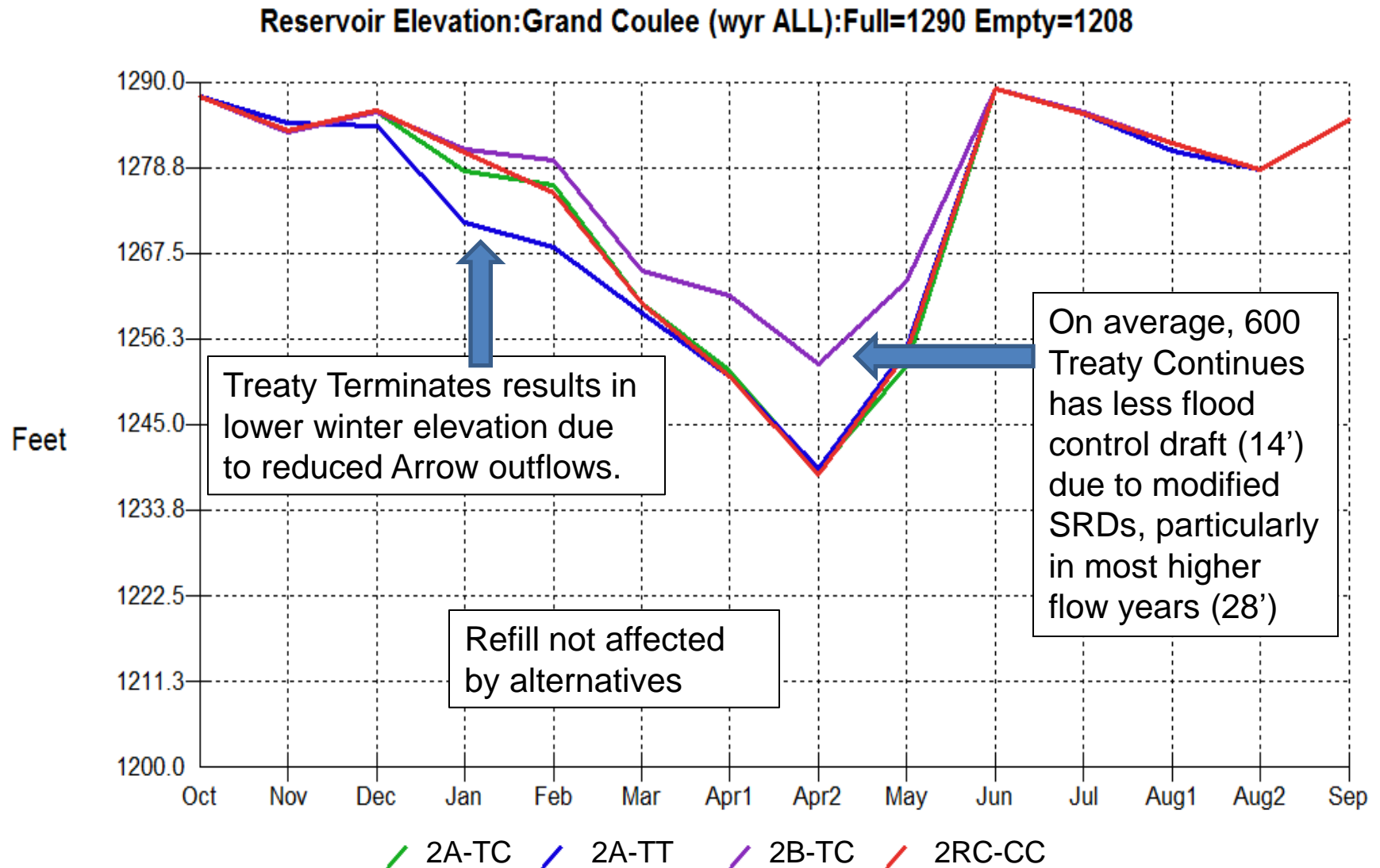


COLUMBIA RIVER

- **FLOWS AT BORDER** — Lake Roosevelt Inflows
- **GRAND COULEE**
- **GRAND COULEE DAM OUTFLOWS**

GRAND COULEE

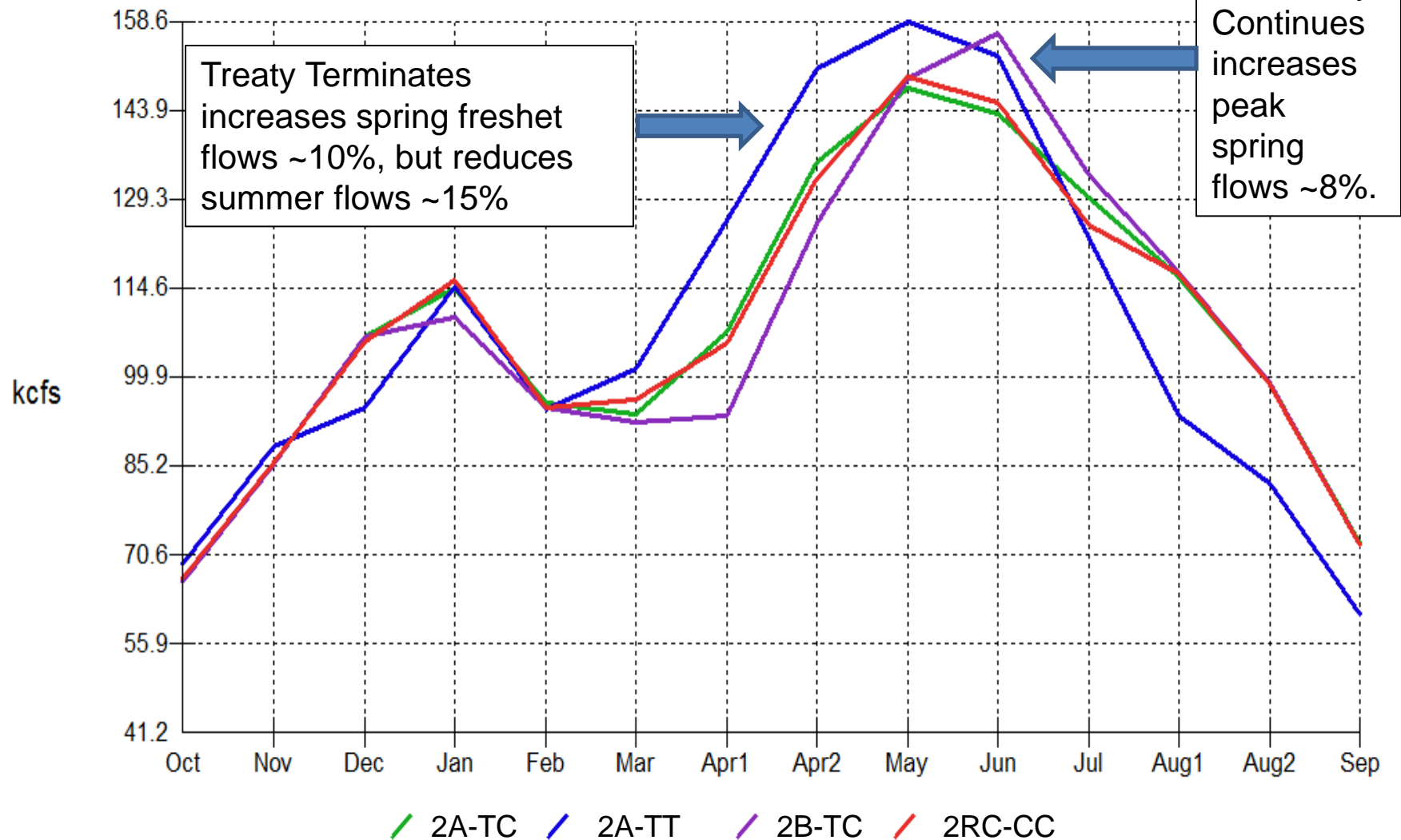
Elevation – 70 Water Years



GRAND COULEE

Outflows - 70 Water Years

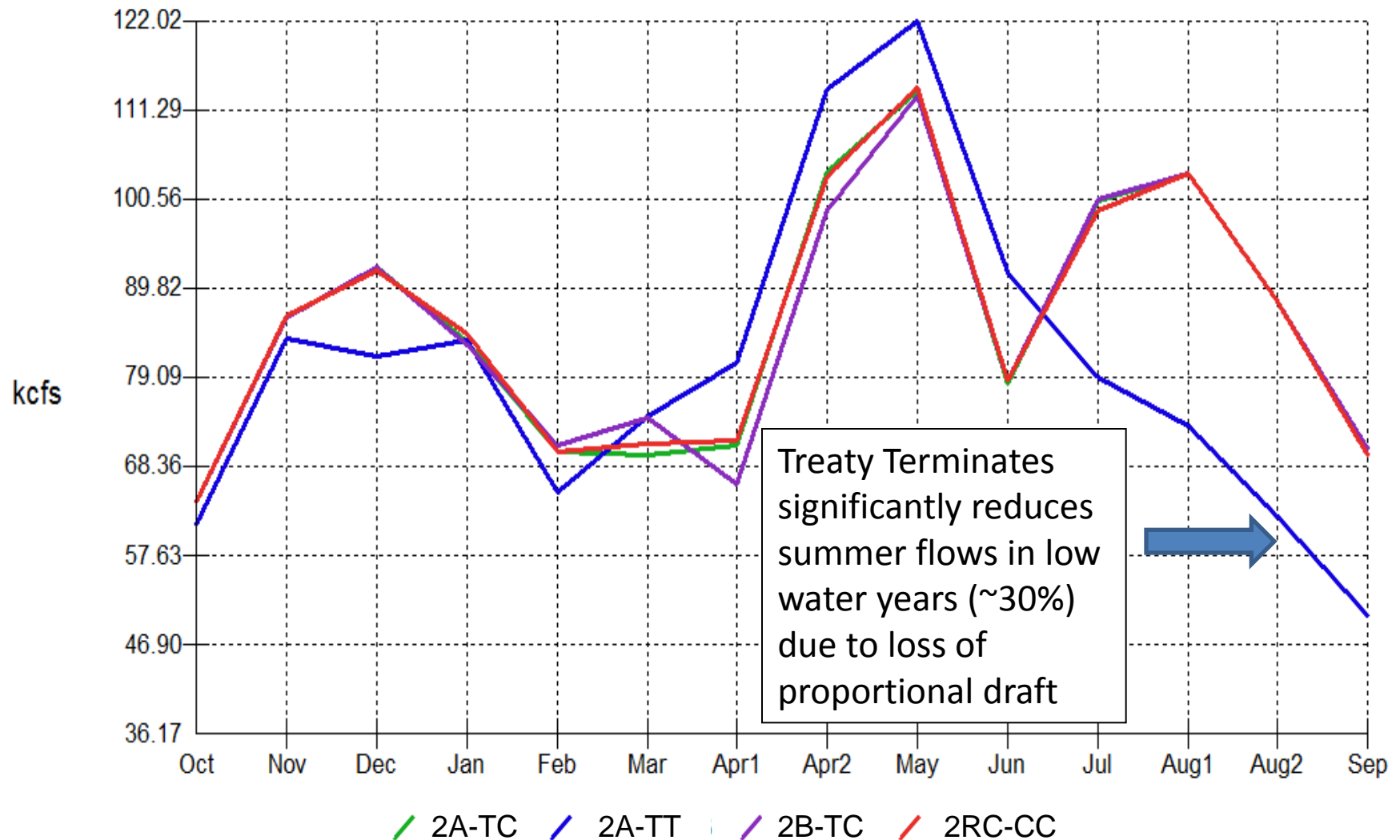
Regulated Outflows:Grand Coulee (wyr ALL)



GRAND COULEE

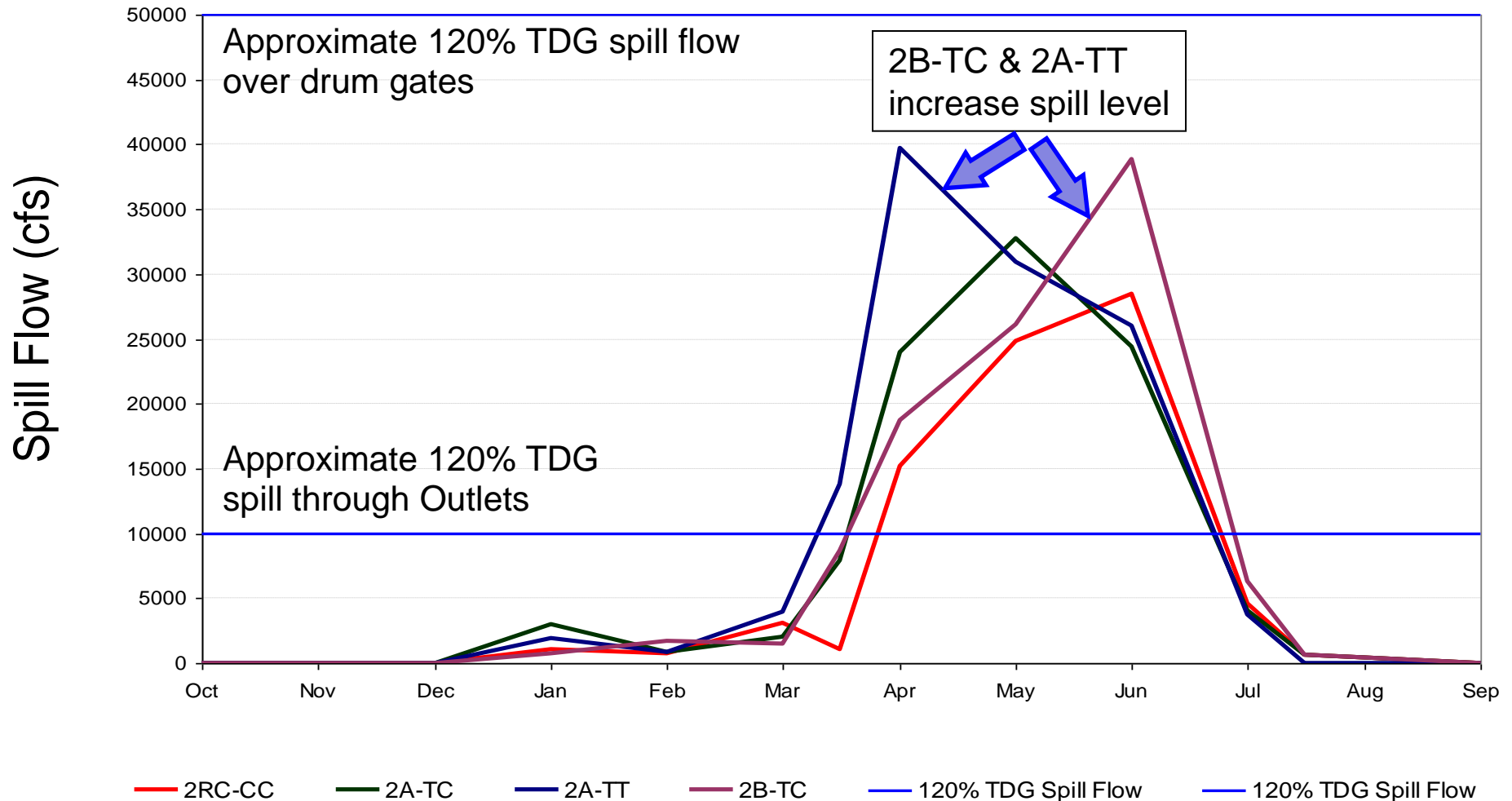
Outflows – 20 % Low Water Years

Regulated Outflows:Grand Coulee (wyr L20)



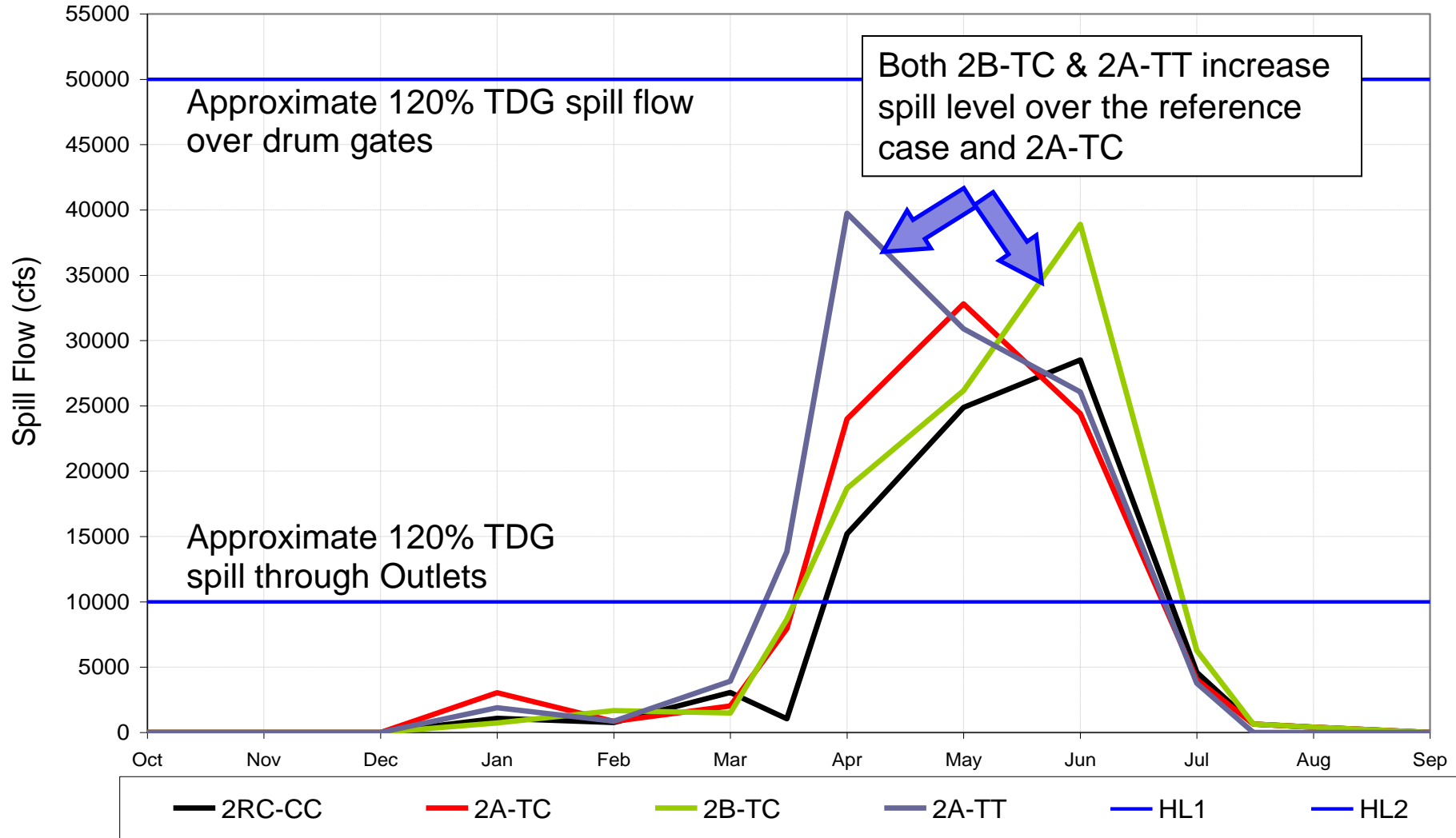
Columbia River Treaty 2014/2024 Review

Grand Coulee - Average Spill - High 20% Years



Columbia River Treaty 2014/2024 Review

Grand Coulee - Average Spill - Years Above 107000 kaf

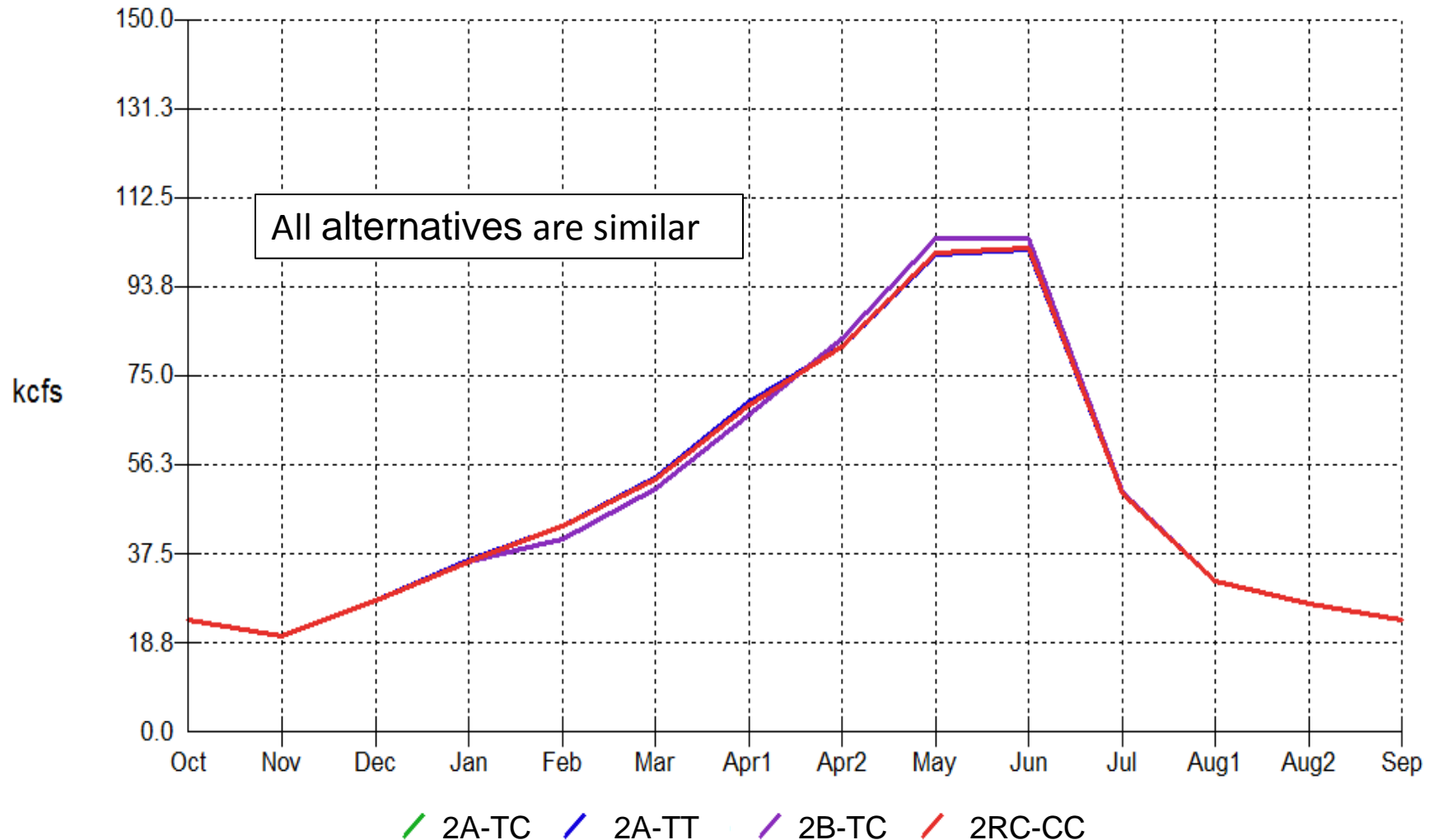


LOWER GRANITE

Outflows

70 Water Years

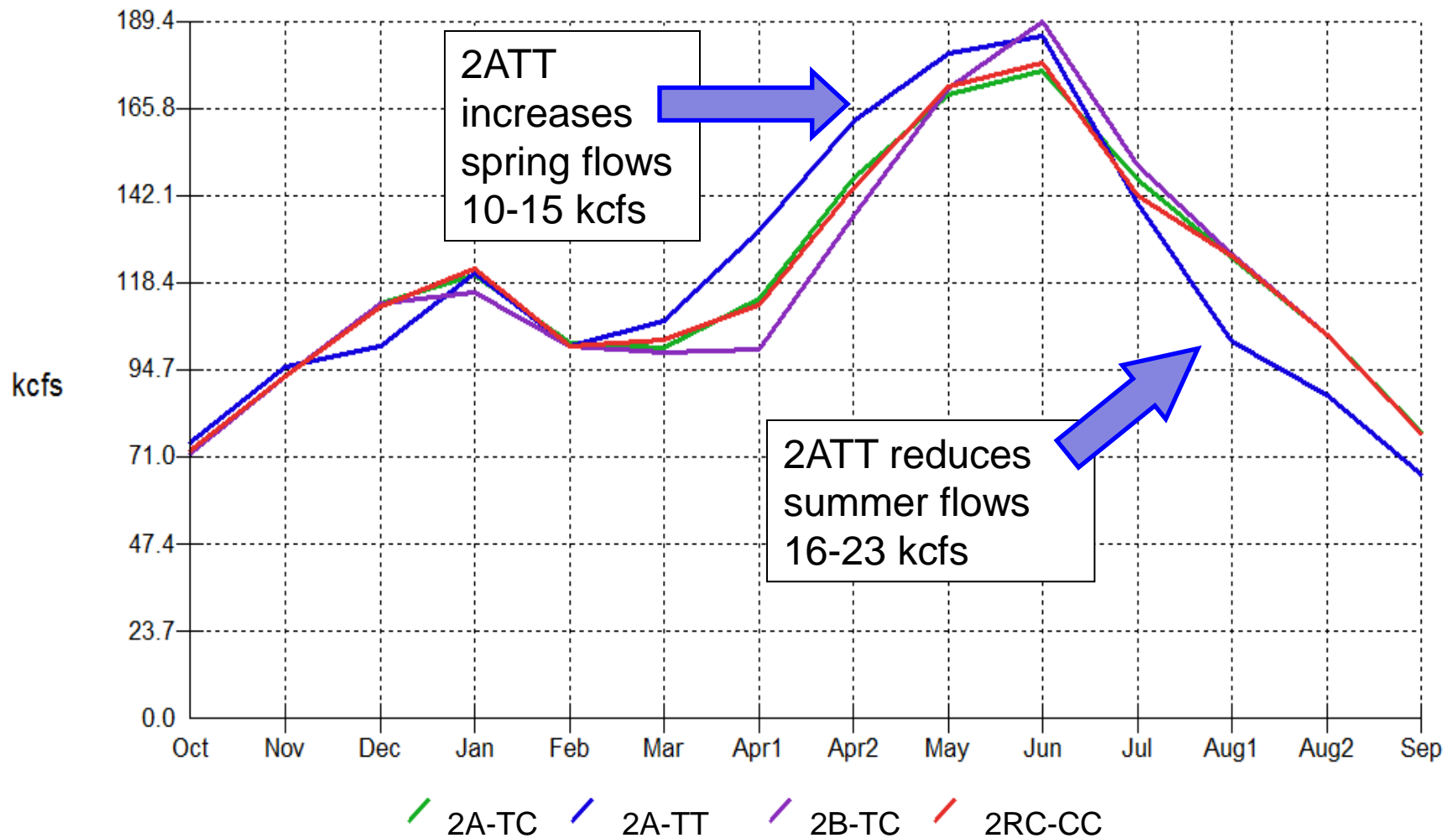
Regulated Outflows: Lower Granite (wyr ALL)



PRIEST RAPIDS

Outflows – 70 Water Years

Regulated Outflows: Priest Rapids (wyr ALL)



Vernita Bar

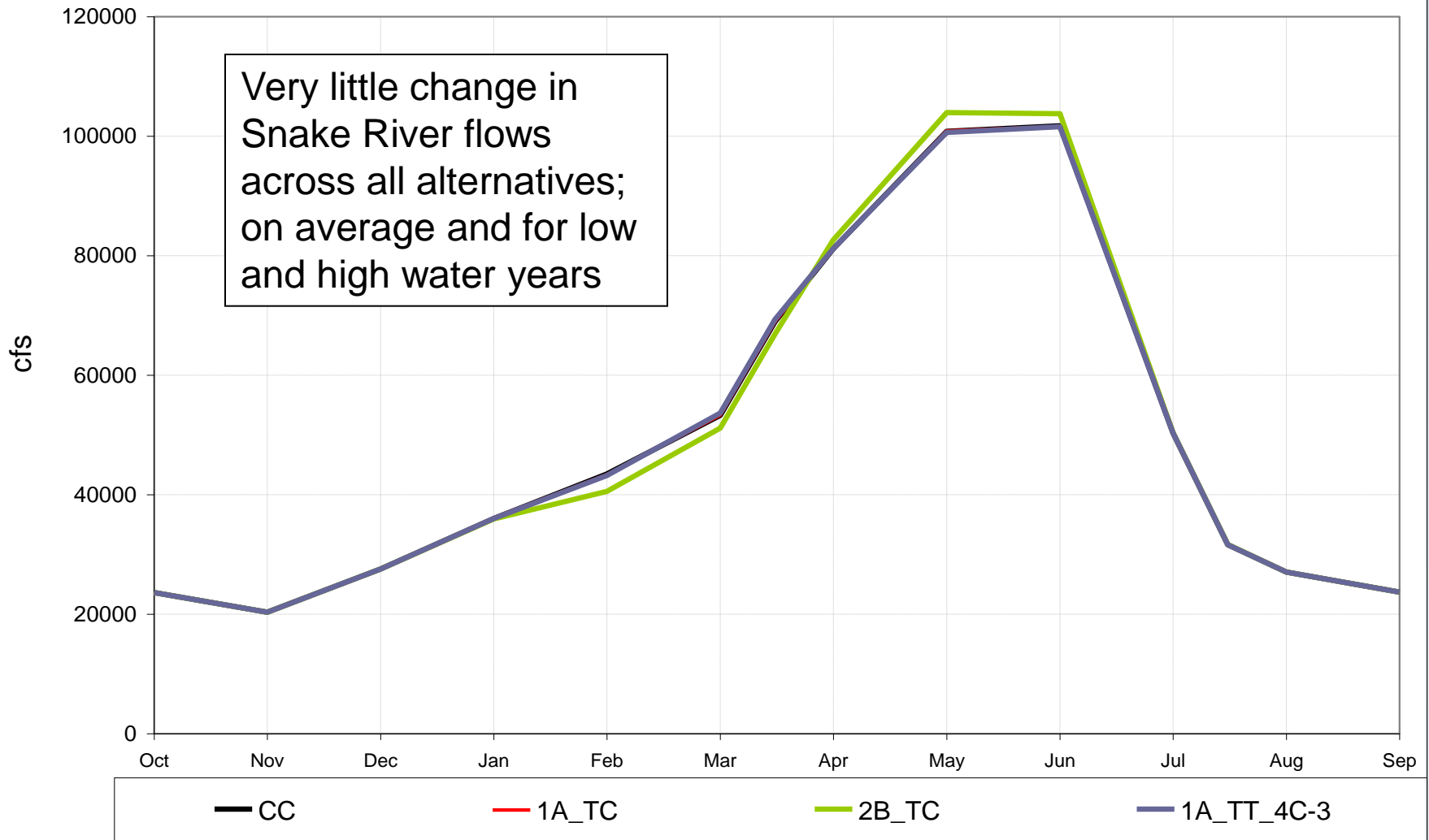
Fall Chinook Spawning/Incubation Flows

(November-April 15: 60-65 kcfs; % met objective)

Alternative	70 Year Average	20% Highest Years	20% Lowest Years
2CC	76%	100%	36%
2A-TT	86%	100%	50%
2A-TC	76%	100%	36%
2B-TC	63%	93%	14%

Columbia River Treaty 2014/2024 Review

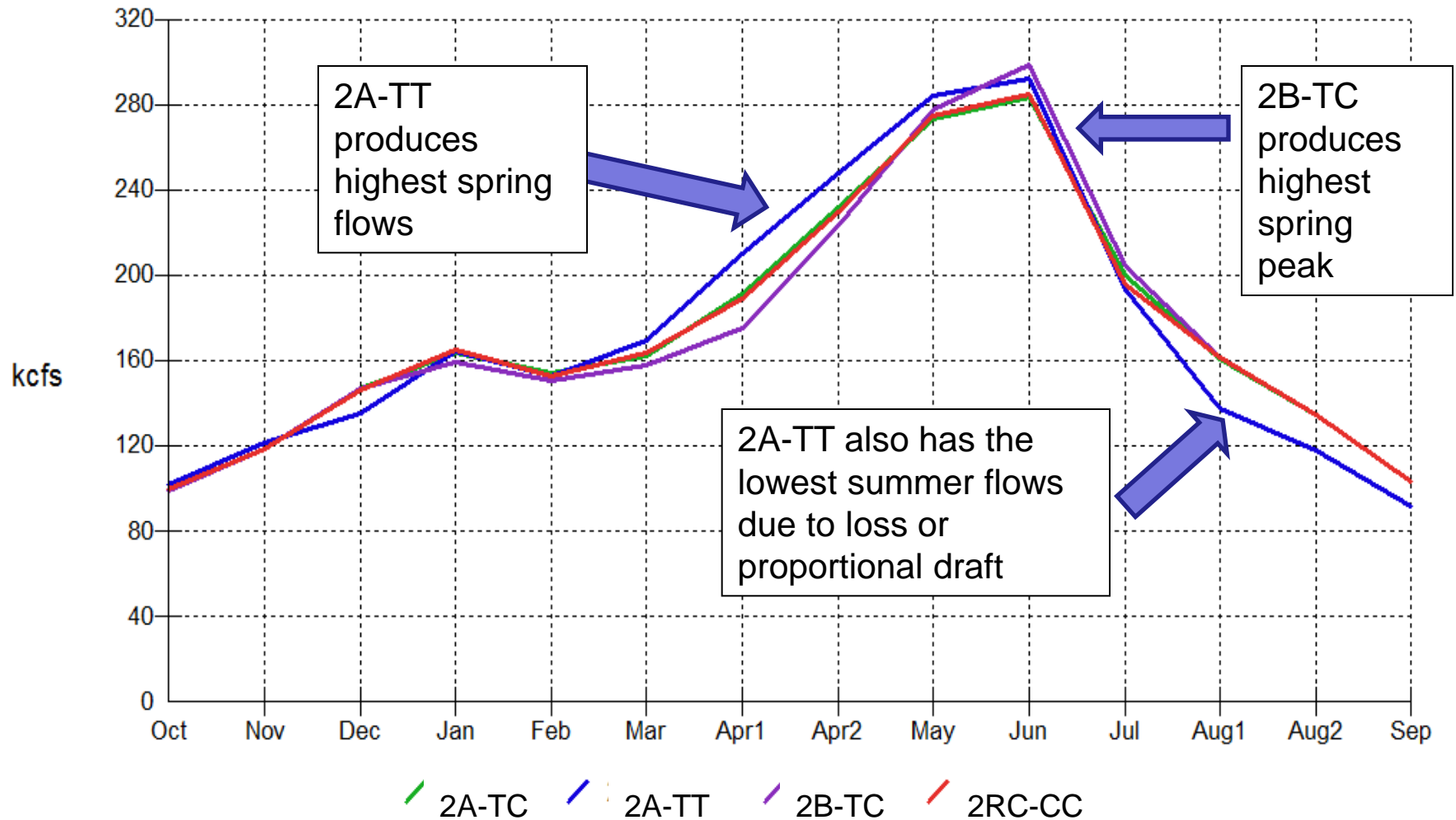
Lower Granite - Average Outflow - All Years



MCNARY

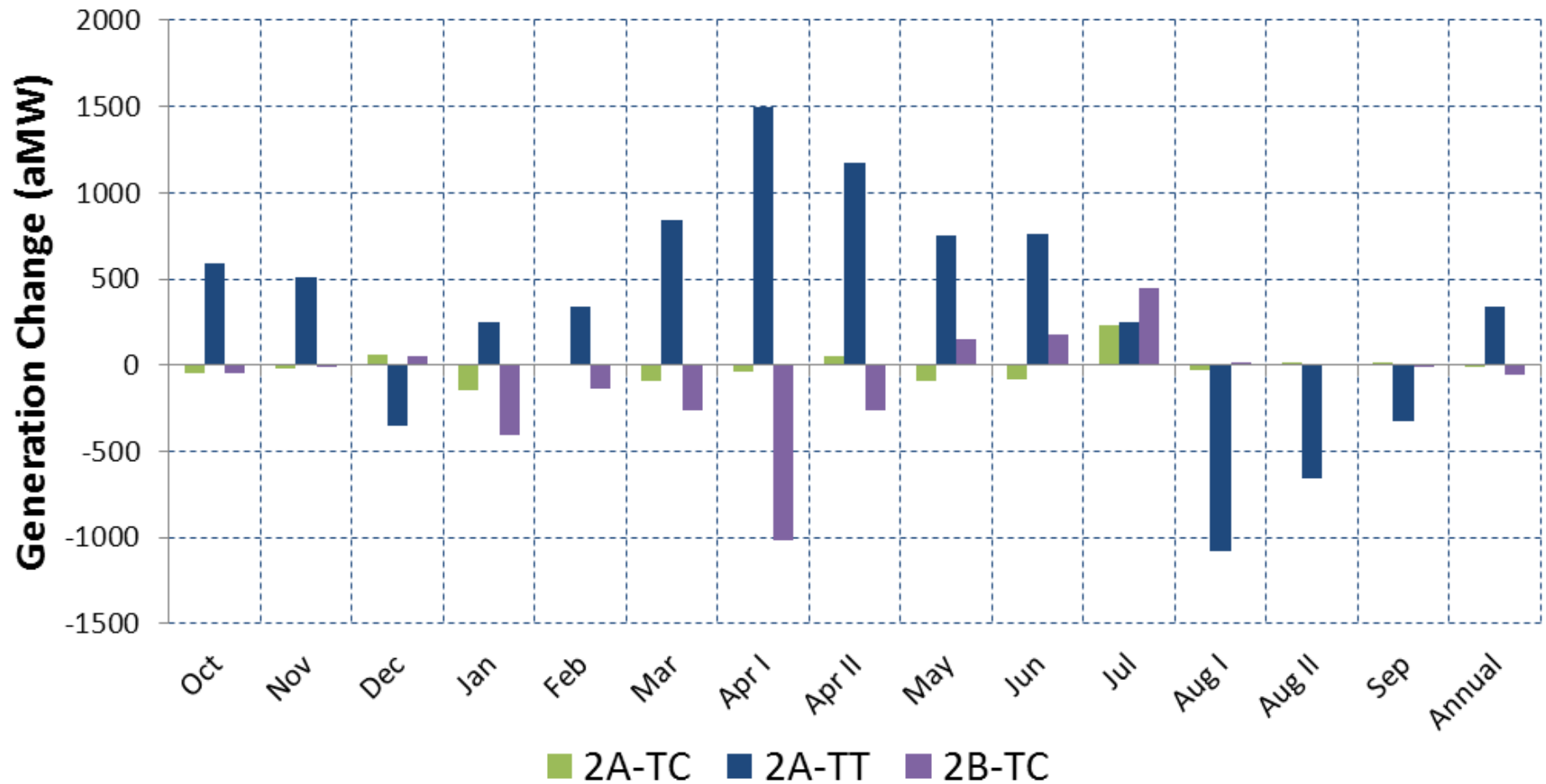
Outflows – 70 Water Years

Regulated Outflows: McNary (wyr ALL)



Columbia River Treaty 2014/2024 Review

US System Generation: Change in Generation from Current Conditions (Less 442 aMW Under Treaty Continues Alternatives)

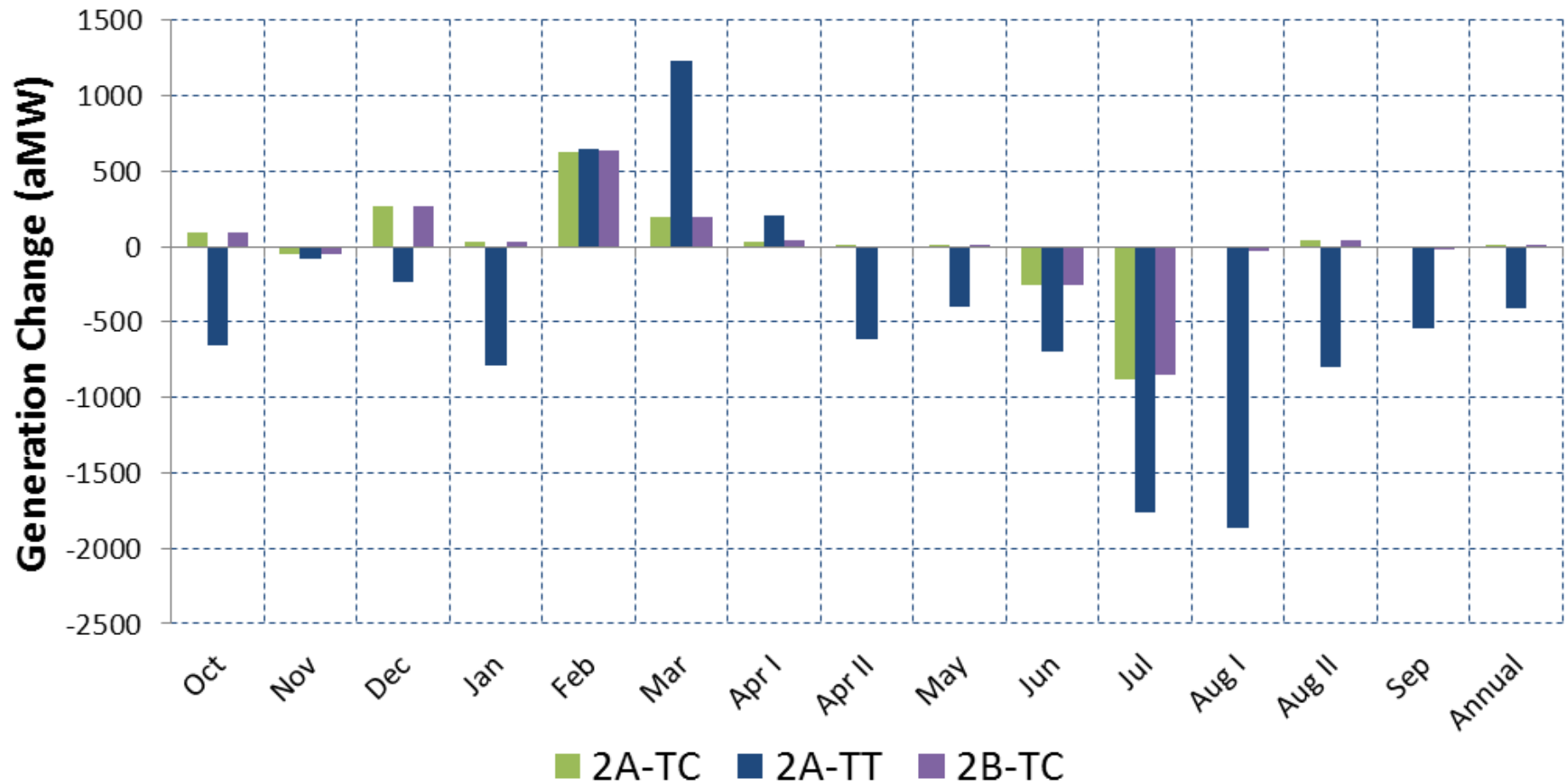


Alternatives Seasonal Generation Change US System

US System Generation (aMW) Adjusted for CEA					
	Fall	Winter	Spring	Summer	Annual
All Water Years					
2RC-CC	9523	13498	14313	13064	12603
2A-TC	-16	-27	-60	46	-14
2A-TT	260	71	970	40	337
2B-TC	-20	-164	-246	211	-54

Columbia River Treaty 2014/2024 Review

Canadian System Generation: Change in Generation from Current Conditions (Plus 442 aMW Under Treaty Continues Alternatives)



Alternatives Seasonal Generation Change Canadian System

Canadian System Generation (aMW) Adjusted for CEA					
	Fall	Winter	Spring	Summer	Annual
All Water Years					
2RC-CC	3748	4351	2628	4359	3769
2A-TC	13	301	74	-374	2
2A-TT	-428	-153	215	-1264	-409
2B-TC	12	302	76	-365	5

Summary

General:

1. Flows and reservoir elevation on the Flathead, Pend Oreille, Spokane, and Kootenai systems varied little across all alternatives
2. Flows from the Snake varied little across all alternatives
3. Treaty Terminates alternative, 2A-TT, resulted in lower winter flows, higher spring flows, and lower summer flows

Ecosystem-based Function:

1. 2A-TT (treaty terminates) provided the higher average spring flows; best met Spring BiOp and Hanford Reach salmon flow objectives

Summary (cont.)

Ecosystem-based Function (cont.):

2. 2A-TT produced lowest mid and late summer flows; would likely impact juvenile fall Chinook downstream and adult fall Chinook, coho and steelhead upstream migrations
3. 2B-TC (600 kcfs) provided the higher average spring flows and met summer BiOp objective better than 2A-TC (450 kcfs) and 2RC-CC (current condition)
4. In 20% low flow years, Spring BiOp flow objectives were rarely met, no alternative met summer BiOp flow objectives and **Hanford Reach** flow objectives are missed in almost all years
5. Most of the results were anticipated but the magnitude of missed biological objectives in low flows is of concern – this needs to be addressed in Iteration #3

Summary (cont.)

Hydropower:

1. Treaty Termination resulted in an overall loss of annual average generation for Canada (approx. 410 aaMW), but an increase for the U.S. (approx. 340 aaMW).
2. For Treaty Termination, the largest loss of U.S. generation was in the Aug-Sep period, approx. 600 aMW. The largest gain was in the spring, approx. 970 aMW.
3. Under Treaty Continues, the 2B-TC alternative resulted in a U.S. loss of generation in the winter of approx. 165 aMW and in the spring of 245 aMW. The 2A-TC generally showed little change from the reference case.